26th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop

Mammoth Lakes, California
June 23-26, 2008

Program

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Meeting Locations

Technical Committee Meeting - Fireside Lounge
Monday Lunch - Mountainside Grill
Monday Night Reception - Dry Creek Bar, Mammoth Mountain Inn
All presentations - Mountainside Conference Center (rooms 4 and 5)
Lunch on Tuesday/Thursday - Main Lodge Sundeck (weather permitting), backup location - Tusk's Bar
Banquet - McCoy station (take the gondola up the mountain)

General Program

Mammoth Lakes, California
June 23-26, 2008

Monday, June 23rd
Technical Committee Meeting (8:00 AM - 5:00 PM)
Registration and evening social (6:00 PM – 9:00 PM)

Tuesday, June 24th
Registration (beginning at 7:00 AM)
Workshop presentations 8:00 AM – 5:00 PM (lunch provided)

Wednesday, June 25th
Field trip to sage-grouse range in Mono County
(lunch and dinner provided during field trip)

Thursday, June 26th
Workshop presentations 8:00 AM – 5:00 PM (lunch provided)
Evening Banquet (6:00 – 9:00 PM)

Program
Monday, June 23rd

8:00 – 5:00 Western Agencies Sage and Columbian Sharp-tailed Grouse Technical Committee Meeting

Technical Committee Members

Scott Gardner – California (Chair)
Jack Connelly – Idaho (Vice-Chair)
Mike Schroeder – Washington (Executive Committee)
Christian Hagen – Oregon (Awards Committee)
Dale Eslinger - Alberta
Tony Apa - Colorado
Tom Hemker - Idaho
Rick Northrup - Montana
Shawn Espinosa - Nevada
Aaron Robinson - North Dakota
Dave Budeau - Oregon
Sue McAdam - Saskatchewan
Tom Kirschenmann - South Dakota
Dave Olsen - Utah
Jason Robinson - Utah
Joe Bohne - Wyoming
Tom Christiansen - Wyoming
Danielle Flynn - BLM
Clint McCarthy - USFS
Patricia Diebert - USFWS

Program
Tuesday, June 24th

8:15 Introductions - ***Scott Gardner***, California Department of Fish and Game

8:20 Welcome to California - ***Sonke Mastrup***, Deputy Director, California Department of Fish and Game

Session Chair - ***Rick Northrup***

8:30 Gunnison sage-grouse: research and conservation - ***Michael Phillips***

8:50 Greater sage-grouse and ESA. Again. - ***Pat Diebert***

9:10 Range-wide needs assessment of sage-grouse local working groups - ***Lorien Belton***, *Douglas Jackson-Smith, and Terry Messmer*

9:30 Managing, safeguarding, and delivering sage-grouse monitoring data for the long-term - ***Sean Finn***, *Linda Schueck, and Thomas J. Zarriello*

9:50 – 10:20 Break

Session Chair - ***Mike Schroeder***

10:20 From the nest to the lek: survival, natal dispersal, and recruitment of juvenile greater sage-grouse in northwestern Colorado. - ***Tom Thompson***, *Kerry Reese, and Anthony Apa*

10:40 Evaluation of assisted brood amalgamation in sage-grouse: can adding domestically-hatched chicks into wild broods support a population? - *Tom Thompson,* ***Anthony Apa****, and Kerry Reese*

Program
Tuesday, June 24th cont.

11:00 Landscape level assessment of brood rearing habitat for greater sage-grouse in east-central Nevada - ***Michael T. Atamian****, James S. Sedinger, and Jill S. Heaton*

11:20 Greater sage-grouse (*Centrocercus urophasianus*) nest success following transmission line construction in northern Nevada - ***Erik J. Blomberg****, Michael T. Atamian, and James S. Sedinger*

11:40 Things that we thought we knew about sage-grouse, but don't: an investigation of dispersal, lek structure, and genetic diversity - ***Krista L. Bush****, Brendan J. Moynahan, Brett W. Walker, Heather S. Sauls, Angela M. Battazzo, Cameron L. Aldridge, Kevin E. Doherty, Jason Tack, John Carlson, Dale Eslinger, Joel Nicholson, Mark S. Boyce, David E. Naugle, Cynthia A. Paszkowski, and David W. Coltman*

12:00 – 1:20 Lunch

Session Chair - ***Shawn Epinosa***

1:20 Invited paper - Sierra Nevada bighorn sheep and domestic livestock - ***Tom Stephenson***

1:40 Sheep, sagebrush, and sage-grouse: managing brood-rearing habitat through strategic intensive grazing - ***Michael R. Guttery****, Roger E. Banner, and Terry A. Messmer*

2:00 Movement patterns and population dynamics of greater sage-grouse in Mono County, California - ***Lief A. Wiechman****, Kerry P. Reese, and Scott C. Gardner*

2:20 Population structure of greater sage-grouse in northeastern California: a preliminary assessment - ***Dawn M. Davis****, Kerry P. Reese, and Scott C. Gardner*

2:40 Caught on the edge: conservation and recovery of sage-grouse at the extremity of their range. the Devil's Garden/Clear Lake population, Modoc county, California - ***Marc Horney****, John Beckstrand, Patty Buettner, Richard Shinn, and Gene Kelley*

Program
Tuesday, June 24th cont.

3:00 – 3:30 Break

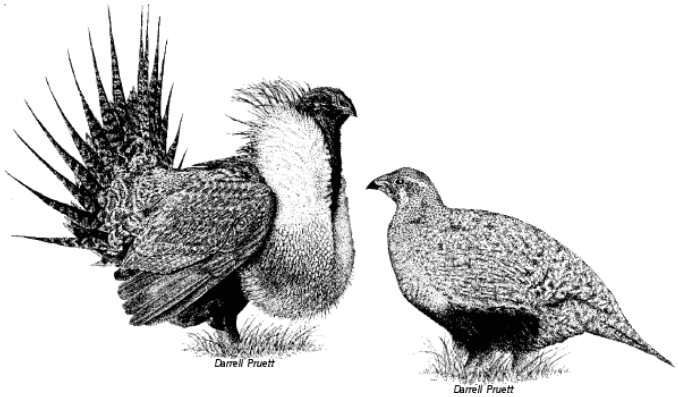
Session Chair - ***Pat Diebert***

3:30 Augmentation of greater sage-grouse at Clear Lake National Wildlife Refuge, Modoc county, California - ***Richard Shinn, Jr.***, *Richard L. Callas, and Robert Wesley Hoyer*

3:50 Augmentation of a greater sage-grouse population in south central Washington - ***Michael F. Livingston***, *Lisa Dunham, Michael A. Schroeder, Colin Leingang, and Dave Hays*

4:10 Reintroducing the Columbian sharp-tailed grouse to Oregon: trials and tribulations and some success - ***Christian A. Hagen***, *Vic Coggins, David A. Budeau, and Michael Hansen*

4:30 Twenty-two years of Columbian sharp-tailed grouse translocations: have we made a difference? - ***Michael A. Schroeder***, *Randy Smith, Ron Greer, Christian Hagen, Doug Jury, Mick Cope, Shawn Espinosa, Richard Whitney, Rick Northrup, and Scott Gardner*



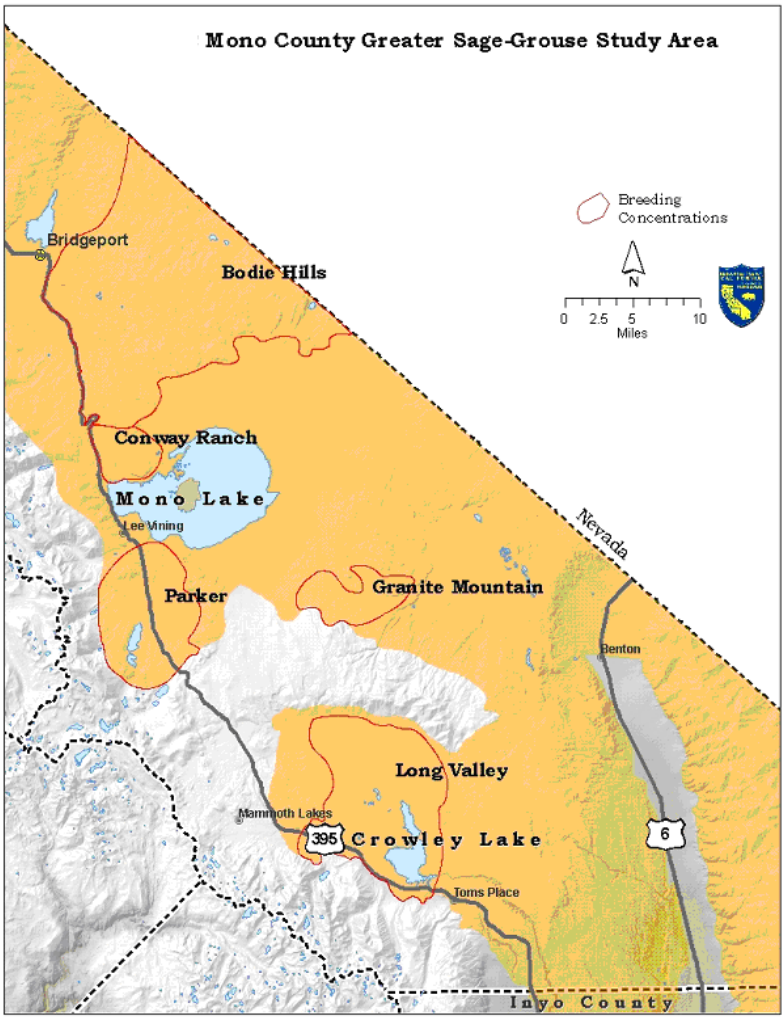
Program
Wednesday, June 25th

Field Trip

7:30	Meet at Mammoth Mountain Inn and load vehicles
8:00	Tour greater sage-grouse range in Long Valley
11:00	View greater sage-grouse range in the Mono Basin from Parker
11:45	Conservation of Mono Lake and bird research in the Mono Basin ***Bartshe Miller***, The Mono Lake Committee
12:00	Lunch at the USFS Visitor's Center in Lee Vining
1:00	Depart Lee Vining for Bodie
1:30	Bodie State Historic Park ***Mark Langner***, California State Parks
2:00	Tour greater sage-grouse range in the Bodie Hills
5:00	Stop in Bridgeport, then return to Lee Vining
6:00	Dinner at Mono County Park, Lee Vining (weather permitting) (backup location - Lee Vining Community Center)
8:15	Return to Mammoth

Program
Wednesday, June 25th

Field Trip



Program
Thursday, June 26th

Session Chair - ***Jack Connelly***

8:00 Predicting sage-grouse nesting habitat at multiple spatial scales - ***Steven Petersen****, Andrew Yost, Mike Gregg, and Rick Miller*

8:20 Occurrence and monitoring of West Nile virus in Oregon greater sage-grouse - ***Robert J. Dusek****, Christian A. Hagen, J. Christian Franson, Erik K. Hofmeister, and David A. Budeau.*

8:40 Survival of greater sage-grouse on the eastern fringe of their range - ***Kent C. Jensen****, Christopher C. Swanson, Mark A. Rumble, Nicholas W. Kaczor, and Katie M Herman-Brunson*

9:00 West Nile virus: ecology and impacts on greater sage-grouse populations - ***Brett L. Walker,*** *and David E. Naugle*

9:20 Estimates of greater sage-grouse juvenile survival in Utah - ***David Dahlgren****, Terry Messmer, and David Koons*

9:40 – 10:10 Break

Session Chair - ***Joe Bohne***

10:10 Using gas chromatography to determine wintering greater sage-grouse diets - ***Eric Thacker****, Dale Gardner, Terry Messmer, Michael Guttery, and David Dahlgren*

10:30 Greater sage-grouse and energy development in western North America - *David E. Naugle,* ***Kevin E. Doherty****, Brett L. Walker, Matthew J. Holloran, and Holly E. Copeland*

11:00 Sage-grouse and energy development in Wyoming: conservation planning to minimize impacts - ***Kevin E. Doherty*** *and David E. Naugle*

11:20 Life on the edge: conservation of a trans-boundary sage-grouse population - ***Jason Tack*** *and David E. Naugle*

11:40 Effects of wildfire (1999-2007) on greater sage-grouse and key sagebrush ecological systems in Nevada - ***Shawn P. Espinosa*** *and Ralph Phenix*

12:00 – 1:20 Lunch

Program
Thursday, June 26th

Session Chair - ***Aaron Robinson***

1:20 Hixon sharptail area - 30 years of conservation action - ***Alan R. Sands*** *and Jason Karl*

1:40 Micro-habitat use of nesting greater sage-grouse in Idaho - ***David D. Musil***

2:00 Nesting success and resource selection of greater sage-grouse in northwestern South Dakota - ***Kent C. Jensen****, Nicholas W. Kaczor, Katie M. Herman, and Christopher C. Swanson, Robert W. Klaver, and Mark A. Rumble*

2:20 Nest site selection of greater sage-grouse: the importance of scale - ***Kevin E. Doherty****, David E. Naugle, and Brett L. Walker*

2:40 The effects of perch discouragers on raptor and corvid use of utility poles - ***Phoebe R. Prather*** *and Terry A. Messmer*

3:00 – 3:30 Break

Session Chair - ***Tom Hemker***

3:30 Predicting the attendance probability of greater sage-grouse at lek sites in south-central Idaho: preliminary analysis - ***Jeremy A. Baumgardt****, Kerry P. Reese, Edward O. Garton, Jack W. Connelly, Dave Musil, and Marc Evans.*

3:50 Lek counts underestimate lek attendance based on genetic sampling of molted feathers - ***Krista L. Bush****, Cameron L. Aldridge, Jennifer E. Carpenter, Dale Eslinger, Joel Nicholson, Mark S. Boyce, Cynthia A. Paszkowski, and David W. Coltman*

4:10 Allee and Ricker effects on persistence of declining sage grouse populations - ***Edward O. Garton****, Jon S. Horne, Katherine Strickler, Ann Moser, Brian Dennis, John W. Connelly, Michael A. Schroeder, and J. Michael Scott*

Abstracts

Gunnison sage-grouse: research and conservation

Michael Phillips, Colorado Division of Wildlife, Ft. Collins, CO 80526

Gunnison sage-grouse (*Centrocercus minimus*) is a newly described species. There are seven Gunnison sage-grouse populations distributed across southwestern Colorado and southeastern Utah. Six of the populations are relatively small (with < 100,000 acres of habitat likely used by grouse) compared to the Gunnison Basin (with more than 500,000 acres of grouse habitat). Temporal variation in demographic rates is thought to have a greater impact on small than large populations and spatial variation in demographic rates may be influenced by landscape structure. A population viability analysis (PVA) was developed for Gunnison sage-grouse in the Gunnison Sage-grouse Conservation Plan. The PVA used the best demographic data available to estimate persistence times; however, not all demographic data were available for Gunnison sage-grouse. A sensitivity analysis predicted juvenile survival, female survival and nest success to be important parameters in population viability. Since we lack information on juvenile survival and current estimates of female survival and nest success (with estimates of temporal and spatial variation), the current PVA of Gunnison sage-grouse is a first approximation of viabiliy. Spatially explicit population models (SEPM) evaluate the effect of landscape features on species abundance, distribution, seasonal habitat use and persistence. These models require information on movement patterns and dispersal. These parameters are also poorly known for Gunnison sage-grouse. Development of management strategies for Gunnison sage-grouse will depend on modeling efforts using estimates of demographic rates and movement patterns. Estimating these parameters and developing models of Gunnison sage-grouse demography and movement is the focus of the current research project by the Colorado Division of Wildlife.

Greater sage-grouse and ESA. Again.

Pat Diebert, US Fish & Wildlife Service, Cheyenne, WY 82009

On January 12, 2005, the U.S. Fish and Wildlife Service determined that the Greater sage-grouse was not in danger of extinction throughout all or a significant portion of its range and that protection under the Endangered Species Act was not warranted. On December 4, 2007, the Ninth District Court remanded that decision back to the Service necessitating a new finding. Significant new biological information has emerged since the previous finding resulting in the need for many new analyses. How the Service will analyze and integrate the new information to inform whether Greater sage-grouse warrants further consideration under ESA will be discussed.

Range-wide needs assessment of sage-grouse local working groups

***Lorien Belton**, Douglas Jackson-Smith, and Terry Messmer,*
Utah State University, Logan, UT 84322

Across the western United States, over sixty local working groups - collaborative stakeholder partnerships - have been established to help conserve local habitat and populations of greater and Gunnison sage-grouse. Participants in these collaborative efforts were surveyed by mail during 2007 to assess the needs of the local working groups. Survey questions addressed general information needs, information format and source preferences, reasons for joining and leaving, meeting experiences, and trust levels in various agencies and institutions. Baseline data on participation, participant profiles, levels of investment in the group's work, and reports of challenges and successes were also gathered. Findings include high levels of trust in state wildlife agencies and university researchers, and greater interest in information that comes from in-person, rather than electronic, sources. How to protect landowners from the effects of possible endangered species listing was ranked among the most critical information needs. These and other results have the potential to help direct resources to better support the efforts of local working groups.
This work was supported by a USDA Natural Resources Conservation Service Fish and Wildlife Conservation Grant.

Managing, safeguarding, and delivering sage-grouse monitoring data for the long-term

***Sean P. Finn**, Linda Schueck, and Thomas J. Zarriello,* USGS Forest and Rangeland Ecosystem Science Center, Boise, ID 83706

The USGS Snake River Field Station, host of the SAGEMAP (http://sagemap.wr.usgs.gov) and Great Basin Information Project (GBIP; http://greatbasin.nbii.gov) web portals, strives to serve the sagebrush biome and all of its diverse inhabitants by delivering high quality, spatially robust data to support research and management of this threatened ecosystem. The U.S. Geological Survey embraces WAFWA's Greater Sage-grouse Comprehensive Conservation Strategy goal of "maintaining and enhancing populations and distribution of sage-grouse by protecting and improving sagebrush habitats and ecosystems that sustain these populations," We also agree that, "developing partnerships to design and implement actions to support robust populations of sage-grouse and the landscapes and habitats upon which they depend," is a sound strategy to manage this wide-ranging species. SAGEMAP and GBIP have been working to realize many of the data coordination and delivery objectives outlined in WAFWA's Conservation Strategy. This presentation will discuss how SAGEMAP/ GBIP's existing network infrastructure is already positioned to assist sage-grouse and sagebrush professionals with organizing and delivering information in a way that is highly consistent with the stated objectives of the Conservation Strategy. We will summarize and demonstrate how SAGEMAP and GBIP currently address many of the specific Conservation Strategy objectives related to research coordination, data management, and partnership development. Building upon this foundation, we will discuss approaches for quickly and effectively addressing upcoming and long-term data management needs and opportunities to support collective goals for Greater sage-grouse and sagebrush conservation and management.

From the nest to the lek: survival, natal dispersal, and recruitment of juvenile greater sage-grouse in north-western Colorado

***Tom Thompson**, Kerry. Reese,* University of Idaho, Moscow, ID 83844 *and Anthony Apa,* Colorado Division of Wildlife, Grand Junction, CO 81505

Juvenile survival, dispersal, and recruitment are important factors influencing the persistence and growth of wildlife populations. There is currently limited information on how these factors could be contributing to the recent and wide-spread decline in greater sage-grouse (*Centrocercus urophasianus*) populations. In 2005 we initiated this study to determine these rates by radio-marking and tracking individuals from their natal nest through first breeding season. Between 2005 and 2007 we radio-marked 578 chicks from 129 broods at 1-3 days post-hatch, and then at 16-weeks of age we radio-marked 153 juveniles (103 known from hatch and 50 random). Survival to 16 weeks averaged 29.0% and was variable among years. After 16-weeks survival was consistent over the 3 years. For both genders survival was lowest during the fall compared to the winter (74.5% and 96.3%, respectively), and was approximately 14% lower for males during the fall. Overall survival of juveniles from hatching to entering the breeding population the following year was 15.3% and differed among years. Greater than 98% of all juveniles returned to the populations where they were produced or captured. During the first breeding season, all juvenile males were greater than 2 km from the natal area (average 6.3 km). In contrast, 67.0% of all females were within 2 km of their natal area (average 3.7 km). Our results indicate that juvenile survival and recruitment can be highly variable between years and that these factors most likely influence population persistence and growth at much smaller spatial scales (lek complex or local population level) than previously thought. We will discuss possible management implications for these findings.

Evaluation of assisted brood amalgamation in sage-grouse: can adding domestically-hatched chicks into wild broods support a population?

Tom Thompson, University of Idaho, Moscow, ID 83844, ***Anthony Apa****, and Kerry Reese,* Colorado Division of Wildlife, Grand Junction, CO 81505

The decline in greater sage-grouse (*Centrocercus urophasianus*) populations over the last 30 years, particularly in fringe and low density populations such as in Alberta, Washington, Utah, California and Colorado have fueled wildlife agencies to consider using translocation of adult grouse as a management strategy to supplement declining populations. A potential alternative to the translocation of reproductively-active adults would be to supplement broods of successful females in those population with wild chicks that were hatched and raised in captivity (i.e., domestically-hatched). Between 2005 and 2007, we developed and investigated the feasibility of this management technique on 2 populations in northwestern Colorado. Over the course of this study we collected 302 eggs from both laying and incubating radio-marked females and incubated and hatched them in captivity. Chicks were then raised to either1-4 days (treatment 1) or 5-9 days (treatment 2) before being placed into unrelated wild broods within the 2 study areas. We successfully introduced 72.3% (120/166) of all chicks that hatched into wild broods. Adoption rate over the 3 years was over 95% successful. Survival of chicks varied over the 3 years, but averaged at 25.4% (95% CI: 18.6 – 34.8%) to 40 days of age. There was no difference in survival between treatment 1 and treatment 2 (T1: 27.5%, 95% CI 18.8 – 40.4% and T2: 22.2%, 95% CI 12.9 – 38.4%) or with radio-marked wild-hatched chicks in the same study areas (35.7%, 95% CI: 31.3 – 40.6%) over the 3 years. Details of the procedure will be presented.

Landscape level assessment of brood rearing habitat for greater sage-grouse in east-central Nevada

Michael T. Atamian[1]*, James S. Sedinger, and Jill S. Heaton,*
University of Nevada - Reno, Reno, NV 89512

Models that delineate suitability of Greater Sage-Grouse (hereafter sage grouse) nesting or brood rearing habitat at the landscape scale can provide key insights into the relationship between sage grouse and the environment, allowing managers to identify and prioritize habitats for protection and restoration. We show that SWReGAP landcover types are functional descriptors of sage grouse brood rearing habitat at the landscape scale during both the early and late brood rearing period. Using an Ecological Niche Factor Analysis we examined the effect these landcover types and other ecogeographical variables have on sage grouse selection of brood rearing habitat and generated habitat suitability maps. Early brood rearing habitat represents 36% of our 6500 km2 study area and we found only minor selection for specific habitat types during this period. Our analyses suggest habitat may not be limiting sage grouse populations in east-central Nevada during early brood rearing. In contrast, late brood rearing habitat represents only 2.8% of the study area and had a highly restricted distribution, especially when accounting for brood success. We found strong preference for particular landcover types during late brood rearing, suggesting the potential that such habitat could limit sage grouse populations in east-central Nevada. We also assessed the importance of the incorporation of a fitness component in these types of spatial analyses of habitat quality. Our results suggest that cost of incorporating a fitness component was not always justified and that the decision to do so should be based on the condition of the study area and the goals of the study.

1 Present address: Washington Department of Fish and Wildlife, Spokane Valley, WA 99216

Greater sage-grouse (*Centrocercus urophasianus*) nest success following transmission line construction in northern Nevada

Erik J. Blomberg*, Michael T. Atamian, and James S. Sedinger,*
University of Nevada - Reno, Reno, NV 89512

Decreased nest success may contribute to recent population declines of greater sage-grouse **(***Centrocercus urophasianus***)**. Habitat degradation that decreases shrub cover and grass height is likely to increase nest failure. Additionally, elevated structures such as transmission lines may indirectly increase nest failure by attracting avian nest predators. We used radiotelemetry to monitor female greater sage-grouse and monitor nest success from 2003 to 2007 following the construction of a transmission line in Eureka County, Nevada. We used spatial and vegetative characteristics associated with each nest as covariates in a nest survival analysis in Program MARK. Over 5 years we monitored 133 nests, 121 of which were included in analysis. The best-supported covariates were: percent shrub cover on 10 m transects centered at the nest bowl (PSC), percent cover in the m^2 surrounding the nest (NMT), and distance to the hen's lek of capture (DLC). All three covariates were positively related to daily nest survival. Covariates describing grass height and distance from the nest to the transmission line did not receive support in any top-ranked model. We estimated overall nest success in the study area at 0.196 (± 0.016 SE). Management should focus on promoting dense shrub cover to provide adequate nesting habitat, which should be maintained at various distances from active leks. Future work will investigate potential distance-independent impacts of the transmission line, and whether relatively low nest success is adequate to maintain population viability in the study area.

Things that we thought we knew about sage-grouse, but don't: an investigation of dispersal, lek structure, and genetic diversity

Krista L. Bush, University of Alberta, Edmonton, Alberta, Canada, T6G 2E9, *Brendan J. Moynahan, Brett W. Walker, Heather S. Sauls, Angela M. Battazzo, Cameron L. Aldridge, Kevin E. Doherty, Jason Tack, John Carlson, Dale Eslinger, Joel Nicholson, Mark S. Boyce, David E. Naugle, Cynthia A. Paszkowski, and David W. Coltman*

Sage-Grouse have been intensively studied for the last 30 years, but many important features of their biology have been left unanswered due to limitations of conventional ecological methods. Genetics has the ability unearth cryptic behaviors, family structure, and dispersal, all of which contribute to and refine our knowledge of the species. The objective of this research was to use two populations of Sage-Grouse to examine basic population dynamics using genetics. 2519 individuals were genotyped from 104 leks in Alberta, Saskatchewan, Montana, and Wyoming at 13 microsatellite loci. I found high genetic diversity and low differentiation within both populations despite natural and anthropogenic fragmentation, peripheral and marginal habitat, and declining numbers in both populations. Patterns of isolation by distance and individual assignment showed that most Sage-Grouse in Northern Montana are dispersing between 0 – 250 km, but some disperse up to 350 km. In the Powder River Basin, birds disperse shorter distances (0 – 60 km), with the maximum being 120 km. At the lek level, male kinship is not the driving force behind lek formation. With the exception of one lek that was composed primarily of inbred brothers, all other leks exhibited low levels of first-degree relative pairs for both sexes revealing a lack of familial structure within leks and both philopatry and dispersal in males and females. These results show that declining populations/regions are not inbred or isolated, Sage-Grouse are capable of dispersing over 250 km greater than previously detected, and leks are composed primarily of unrelated individuals.

Sheep, sagebrush, and sage-grouse: managing brood-rearing habitat through strategic intensive grazing

Michael R. Guttery*, Roger E. Banner, and Terry A. Messmer,* Utah State University, Logan, UT 84322

Research has shown that brood-rearing habitat (typically characterized by lower sagebrush cover and greater forb and grass cover) may be limiting some greater sage-grouse populations. Traditional methods of manipulating sagebrush for sage-grouse (Dixie harrow, Lawson aerator, herbicides) are fossil-fuel intensive, controversial on public lands, often short lived, and must be applied at large scales to be economical. Recent studies suggest that strategic intensive grazing by domestic sheep may have the potential to replace, or supplement, conventional methods of managing sage-grouse habitats. This study consists of 8 paired-plots located on similar ecological sites on Parker Mountain, Utah. Plots are approximately 3.2 ha in size and were grazed by 500 sheep for 7-10 days in October and November 2006. We observed a reduction in sagebrush cover from 27.3% to 8.6% in grazed plots whereas coverage increased in control plots during the same period. Coverage of forbs and grasses was lower in July 2007 than in 2006 for both control and grazed plots. This may be due to poor precipitation and heavy livestock grazing during the early summer of 2007. Despite the poor forb and grass response, surveys indicate that sage-grouse preferentially chose to use grazed plots more than control plots during the early brood-rearing period. Preliminary data suggest that strategic intensive sheep grazing may be a viable option for managing sage-grouse brood-rearing habitat. Additionally, sheep grazing can be applied with precision, allowing managers to achieve a desired level of utilization in areas and at scales where it will be most beneficial.

Movement patterns and population dynamics of greater sage-grouse in Mono County, California

Lief A. Wiechman*, Kerry P. Reese,* University of Idaho, Moscow, ID 83844, *and Scott C. Gardner,* California Department of Fish & Game, Sacramento, CA 95814

Research has shown that the greater sage-grouse along the California-Nevada border in Mono County are genetically and geographically isolated from populations in the rest of the species range. This, along with the potential geographic isolation between breeding populations within Mono County, requires a better understanding of sage-grouse in the region for proper management. The goals of this study are to determine demographic rates (survival, productivity), movement patterns, and habitat use and suitability of grouse in the county. This study is also investigating sage-grouse movement corridors, which will provide understanding of the connectivity or lack thereof, between grouse breeding populations in Mono County. To meet these objectives, movements of radio-marked birds are being monitored year-round to evaluate habitat use, interaction between the sage-grouse located in the discrete populations, and to determine survival and mortalities including those deaths attributed to West Nile virus. While most habitat requirements of sage-grouse have been described, nocturnal roost site selection has been largely overlooked. This study is investigating nocturnal roost site selection of broods, as they move from nesting habitat to late brood-rearing habitat. Preliminary results, including production and survival from data collected in 2007 and 2008 will be included in the presentation. The ultimate goal of this research is to identify specific areas in the county that are important for the long-term persistence of sage-grouse.

Population structure of greater sage-grouse in north-eastern California: a preliminary assessment

Dawn M. Davis*, Kerry P. Reese,* University of Idaho, Moscow, ID 83844, *and Scott C. Gardner,* California Department of Fish & Game, Sacramento, CA 95814

Reports of local and range-wide declines in greater sage-grouse populations have traditionally focused attention on factors influencing the distribution and abundance of sage-grouse. These declines are generally attributed to habitat loss and fragmentation; yet, little is known about the effects of habitat fragmentation on sage-grouse populations. In northern California, loss and fragmentation of suitable sagebrush habitat appears to have split sage-grouse populations into smaller, loosely connected lek complexes, potentially leading to isolation of local populations that may have historically been part of a larger metapopulation. However, the connectivity of habitats suitable for sage-grouse has not been studied in California and little is known about the levels of intra- and interpopulation genetic variation, population structure, or how sage-grouse respond to habitat fragmentation. Accordingly, we initiated a 3-year study to assess the relationship between dispersal, gene flow, and genetic structure of 4 lek complexes in a population of sage-grouse in northeastern California. Preliminary results from data collected in 2007-08 will be presented and discussed.

Caught on the edge: conservation and recovery of sage-grouse at the extremity of their range. The Devil's Garden/Clear Lake population, Modoc County, California

Marc R. Horney, USDA-NRCS Klamath Basin Watershed Team, Yreka CA 96097, *John Beckstrand,* USFWS Klamath Basin NWR Complex, Tulelake, CA 96134, *Patty Buettner,* USFS Modoc National Forest, Tulelake, CA 96134, *Richard Shinn,* California Department of Fish & Game, Alturas, CA 96101, *and Gene Kelley,* USDA-NRCS, Tulelake, CA 96134

This paper presents work to date on an effort to recover a virtually extirpated population of greater sage-grouse in Modoc County, CA which lies at the outer boundary of the species reported original range. For this population, the primary biological threat is its small size (<50) and isolation, and the primary habitat threat is the significant expansion of western juniper into the original Low/Lahontan/Big sagebrush communities and the resulting habitat fragmentation. The local recovery effort, which is focused on a 250,000 acre management area, largely on USFS and USFWS managed lands, has grown from the establishment of a Local Working Group to significant inter-agency coordination (USFWS, USFS, BLM, NRCS, NPS, CDFG), support from adjoining states (NDOW, ODF&W) and collaboration with private landowners and Cooperative Extension. We discuss processes and methods that have been used for habitat inventory and assessment, threat assessment, and the evolution of a strategic plan for population stabilization and recovery in a complex environment. A multi-year grouse translocation effort currently underway will be mentioned as part of the strategic process, but the emphasis of this presentation will on inventory, assessment, and management of habitat components.

Augmentation of greater sage-grouse at Clear Lake National Wildlife Refuge, Modoc County, California

Richard Shinn, Jr., California Department of Fish & Game, Alturas, CA 96101, *Richard L. Callas, and Robert Wesley Hoyer,* California Department of Fish & Game, Montague, CA 96064

The Devil's Garden in northeastern California once supported a robust population of greater sage-grouse (*Centrocercus urophasianus*). In the late 19th Century, settlers to the area reported encountering numbers of sage-grouse that seemed limitless. Anecdotal information obtained from the 1920's through the 1980's, along with harvest surveys and lek counts, indicated this population had declined substantially. In the late 1940's, 46 active leks were known on the Devil's Garden. Of those, only one lek located at the Clear Lake National Wildlife Refuge (CLNWR) remains active. In 2003 and 2004, counts of male sage-grouse at this lek were 7 and 12, respectively; causing concern that this group of birds was unlikely to persist without augmentation. Since 2005, a total of 66 greater sage-grouse was translocated to CLNWR. Translocated grouse were monitored to determine nest success, habitat use, movements, and survival. By the fall of 2007, 18 translocated birds were known to be alive and the status of 8 birds was unknown. Of 13 nesting attempts documented in 2007, 11 nests were predated, 1 nest was abandoned, and 1 nest was successful. In 2008, 19 additional sage-grouse were translocated to the CLNWR. Further study is needed to identify factors limiting this population.

Augmentation of a greater sage-grouse population in south central Washington

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Washington state's greater sage-grouse population has declined substantially in abundance and distribution. Two relatively isolated populations separated by roughly 50 km remain. The 2007 population estimate was 800, with 600 in north central Washington and 200 in south central Washington. Mitochondrial haplotype analysis has indicated that genetic diversity has likely declined in conjunction with population declines. An augmentation project was initiated in an attempt to reverse these trends in the south central population, which occupies the Army's Yakima Training Center (YTC). A total of 55 females and 6 males from genetically diverse populations in northern Nevada and southern Oregon were equipped with radio-transmitters and translocated in March 2004, March 2005 and August 2006. Year-round monitoring for reproductive success, survivorship, and movements was conducted through August 2007. A total of 38 nests were located over 4 breeding seasons. Estimates for nesting likelihood, nesting success and fledging success were 55%, 59%, and 66%, respectively. A total of 25 chicks were known to have survived beyond 50 days of hatching. The raw annual survival estimate was 58%. Overall survival was reduced by high initial mortality of the birds translocated in August 2006; the majority (73%) of which were chicks. Mean dispersal distance from release sites was 19 km for Nevada birds and 7 km for Oregon birds. Most remained on YTC and were frequently observed with resident sage-grouse. The short-term objective of introducing genes from healthy populations appears accomplished. Future sampling will be conducted to assess genetic infusion. The long-term objective of reversing population declines will be assessed through annual lek monitoring.

Reintroducing the Columbian sharp-tailed grouse to Oregon: trials and tribulations and some success

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In 1968, the last of Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) were documented in Oregon. After 23 years of relative quiet in the grasslands of northeast Oregon, sharp-tailed grouse were heard cooing and rattling once again. Since 1991, 389 sharp-tailed grouse have been translocated into Wallowa County Oregon in an attempt to restore this native game bird. After 19 years of translocation and augmentation the results have been mixed with a few years of positive response from an infusion of new adult birds, and years of population crashes, perhaps from severe winters. The success of these translocations has largely been measured with the attendance of males at lek sites, and total counts of birds from systematic flush counts during late summer. More recently we have combined the use of radio-telemetry and these methods to better enumerate the population at hand. We discuss methods for translocation, monitoring the success of those efforts, and provide some recommendations for future efforts.

Twenty-two years of Columbian sharp-tailed grouse translocations: have we made a difference?

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Translocation of grouse is a widely accepted tool for re-establishing populations in formerly occupied range and for augmenting existing populations. Despite the simplicity of the concept, there is more to a translocation than just moving birds. Translocations require extensive planning, multi-agency cooperation and coordination, substantial manpower, and subsequent evaluation. We examined Columbian sharp-tailed grouse translocations conducted during the last 22 years in the western United States and British Columbia. Between 1987 and 2008, more than 1,500 sharp-tailed grouse were moved from source populations, primarily in Idaho, Utah, and British Columbia, to target areas in British Columbia, Montana, Washington, Oregon, Nevada, and Idaho. Considerable research and management was done prior to these translocations including a range-wide assessment of genetics, surveys of habitat and grouse at potential source populations and release locations, and habitat acquisition and/or improvement at target locations. The translocation of birds required considerable logistical coordination, usually among multiple agencies. Despite these challenges, the respective agencies have been successful with the 'mechanics' of translocating birds. When sufficient habitat was available at the target location, the translocation efforts appear to have been mostly successful at establishing or improving populations. We believe these cooperative efforts are an excellent model for grouse management.

Predicting sage-grouse nesting habitat at multiple spatial scales

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Current management guidelines describe nesting habitat requirements based on plot-level data at confirmed nest locations. Nest site selection across heterogeneous landscapes, however, is difficult to quantify and consequently less understood. Research is needed that predicts optimal habitat for nesting using both biotic and environmental variables at multiple spatial and temporal scales. The purpose of this research is to develop ecological models using field-based data and geospatial variables to predict nesting habitat in southeastern Oregon. Between 1994 and 2003, female adult sage-grouse were collared and tracked to nest sites at Hart Mountain National Antelope Refuge. At each nest site, coordinate location, vegetation association, aspect, moisture regimes, incident solar radiation, distance to water, and slope were determined using GIS and remote sensing. Ecological models were developed using Non-parametric Multiplicative Regression (NPMR) and Maximum Entropy. From these models, the strongest variables for predicting nest sites were identified and the strength of prediction was determined. Similar methods are being applied to predict habitat use throughout the year at the GI Ranch in Central Oregon. Predictive models can improve management by focusing decisions making processes on those areas that have high probability of supporting birds and to more effectively conserve and restore sagebrush habitats.

Occurrence and monitoring of West Nile virus in Oregon greater sage-grouse

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Following reports of Greater Sage-grouse (*Centrocercus urophasianus*) mortality due to West Nile virus (WNV) in Montana and other sites in 2003 we began an investigation into the occurrence of WNV in sage-grouse in Oregon. We collected samples from live, apparently healthy, sage-grouse beginning in 2004 and from hunter-killed sage-grouse beginning in 2006, as well as investigated reported sage-grouse mortality events. All of the 274 samples from live-captured birds at Hart Mountain National Antelope Refuge and 747 samples from hunter-killed birds have tested negative for specific WNV antibody and infectious virus. In August 2006 we detected our first WNV-positive sage-grouse following a report of dead sage-grouse by a landowner in Malheur County. An investigation at this site revealed 3 fresh sage-grouse carcasses all of which subsequently tested positive for WNV by polymerase chain reaction (PCR). Additionally, 68 carcasses, too decomposed for analyses, were recovered in the immediate vicinity. Observations of live sage-grouse at this location yielded a high count of 34 birds in August, down from approximately 100 birds counted in July by Oregon Division of Fish and Wildlife personnel. Of these, 23 were subsequently sampled and all were negative for WNV or WNV antibodies. Follow-up investigations in 2007 led to counts of 22 live birds in late July and the sampling of 2 birds in August (including 1 moribund bird that was WNV positive). Also in 2006, single carcasses from 2 other sites were recovered and both tested positive for WNV but no other mortality was detected at these locations.

Survival of greater sage-grouse on the eastern fringe of their range

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Greater Sage-grouse (*Centrocercus urophasianus*) populations and the sagebrush (*Artemisia* spp.) habitats they occupy have declined throughout most of their range. In North Dakota and South Dakota, populations of greater sage-grouse are monitored using lek counts to estimate breeding population size. Information from these counts has indicated a declining population trend over the last 50 years. Currently, no empirical information related to survival exists for sage-grouse on the eastern fringe of their range. We located 214 radiomarked adult, yearling, and juvenile (≥10 weeks of age) greater sage-grouse from spring 2005 through winter 2006-07 in North Dakota (n = 81) and from spring 2006 through winter 2007-08 in South Dakota (n = 133). Our objectives were to 1) collect baseline information that identifies seasonal patterns of survival and 2) document causes of mortality and 3) assess factors influencing their survival using Program MARK. We estimated survival during 5 periods: breeding, nesting, early brood-rearing, late brood-rearing, and winter. The majority of all mortalities occurred during the late brood-rearing season (62%), followed by nesting (17%), early brood-rearing (9%), winter (7%), and breeding (5%), respectively. Overall, we documented 133 mortalities including: 99 predation, 8 West Nile virus positives, 7 probable West Nile deaths, 2 weather related, 2 human related, and 15 unknowns. We will present our findings from our analysis in Program MARK evaluating factors influencing seasonal survival and discuss management concerns for greater sage-grouse on the fringe of their range.

West Nile virus: ecology and impacts on greater sage-grouse populations

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A continuing concern in sage-grouse conservation is the spread of West Nile virus (WNv) throughout western North America. West Nile virus has been associated with reduced survival and local and regional population declines in several species, but its long-term impact on populations essentially remains unknown. From 2003-2007, West Nile virus was documented as an important new source of mortality in low and mid-elevation greater sage-grouse populations range-wide. Because WNv can simultaneously reduce juvenile, yearling, and adult survival – three vital rates important for population growth in this species – both persistent low-level WNv mortality and severe outbreaks can lead to local and regional population declines. We used population models and empirical data on mortality and infection rates to explore potential impacts of the virus on greater sage-grouse populations. In simulations, WNv mortality was projected to reduce population growth of susceptible populations by an average of 6-9% per year. However, in most years, population-level impacts of the virus were masked by marked spatial and annual fluctuations in nest success, chick survival, and other sources of mortality. Impacts of severe West Nile virus outbreaks may be detectable in lek-count data, but documenting effects of low to moderate mortality will require intensive monitoring of radio-marked birds during the June-Sept transmission season. Resistance to West Nile virus-related disease is extremely low and is expected to increase only slowly over time. Eliminating mosquito breeding habitat in anthropogenic water sources within sagebrush habitats will be crucial for reducing impacts of West Nile virus in susceptible populations. Better data are needed on geographic and temporal variation in infection rates, mortality, and seroprevalence to understand range-wide impacts of West Nile virus, particularly in peripheral populations and in those experiencing large-scale increases in the distribution of surface water due to energy development.

Estimates of greater sage-grouse juvenile survival in Utah

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Relatively little information exists regarding survival of juvenile greater sage-grouse (*Centrocercus urophasianus*) during brood-rearing periods. We monitored survival by suturing 1.5 gram radios on one-day-old sage-grouse chicks captured on Parker Mountain in south-central Utah. Survival was monitored every two days over 42 days for 21 broods (n = 86 chicks) in 2005 and 21 broods (n = 60 chicks) in 2006. Brood mixing occurred in 21% (n = 31/146) of chicks among 43% (n = 18/42) of monitored broods. The earliest brood mixing occurred at day 5 and continued through the monitoring period. We used a maximum-likelihood version of the Mayfield estimator developed by Manly and Schmutz (2001) to estimate survival, which accounts for potential heterogeneity and fate-dependence among brood members. Our best model (AIC criterion) incorporated age (separated into periods of week 1, week 2, week 3, week 4, and weeks 5 and 6) and brood type. Based on this model, average juvenile survival to 42 days was 0.41 (SE = 0.046). Interestingly, we found little evidence for dependence of survival amongst chicks within broods. Survival was higher for chicks that changed broods relative to those that did not (â = 0.0115, CI = 0.0235, -0.0005). However, we could not determine whether this was caused by our assumptions or whether brood mixing conveyed a real survival advantage. This finding needs further investigation.

Using gas chromatography to determine wintering greater sage-grouse diets

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Greater sage-grouse (*Centrocercus* urophasianus) rely primarily on sagebrush species (*Artemisia* spp.) as their food source in the winter. Research using radio-collared sage-grouse has attempted to describe winter habitats and diet selection. However, without analyzing crop samples it may be difficult to determine diet selection. We conducted a study to determine if chemical analysis of fecal material could be used to identify diet selection and if so, did sage-grouse select black sagebrush (*A.nova*) more frequently than Wyoming big sagebrush (*A. tridentata var. wyomingensis*). The study was conducted during the winter of 2007 and 2008 in Box Elder County, Utah and Wayne County, Utah. Black sagebrush and Wyoming big sagebrush occur extensively in the wintering areas at both sites. We located 30 sage-grouse flocks by locating radio-marked birds. We collected 10 fecal piles and 10 sagebrush samples from each site. The number of birds per flock, habitat type, sagebrush height, sagebrush species, and snow depth were also measured. The samples were extracted using a simple methylene chloride extraction. The terpene profiles for the sagebrush species and sage-grouse pellets were determined using gas chromatography. We identified unique terpene profiles for each sagebrush species and thus we were able to determine which species comprised the fecal pellets thus reflecting diet composition. These data suggest that black sage communities were selected more frequently than Wyoming big sagebrush communities. Using Gas Chromatography, we were able to determine winter diet selection for two sage-grouse populations in Utah without having to use destructive sampling techniques.

Greater sage-grouse and energy development in western North America

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In western North America, rapidly expanding energy development poses a major new challenge for conservation of greater sage-grouse (*Centrocercus urophasianus*). The imminent question is whether mitigation at the local scale can sustain populations as cumulative impacts from energy development increase at the landscape scale. To address this question, we: (1) quantify changes in landscape features detrimental to sage-grouse that result from development, (2) review the scientific literature documenting biological responses of sage-grouse to development, (3) examine the potential for landscape-level expansion of energy development within sage-grouse range, and (4) outline recommended landscape-scale conservation strategies. Whether detrimental effects of landscape features result in population declines depends in part on the magnitude and extent of development. We found that ranch lands developed for energy production contained twice as many roads and power lines, and that where ranching, energy and tillage coincide, human features were so dense that every square kilometer could be bounded by a road and bisected by a power line. Studies have indicated that sage-grouse respond negatively to three different types of oil and gas development, and that conventional well densities far exceed the species' threshold of tolerance. These patterns were consistent among studies regardless of whether they examined lek dynamics or demographic rates of specific cohorts within populations. Severity of current and projected impacts dictates the need to shift from local to landscape conservation. The immediate need is for planning tools that overlay the best remaining areas for sage-grouse with the extent of current and projected development. Tools will enable stakeholders to consider a hierarchy of set-aside areas, lease consolidations and more effective best management practices as creative solutions to reduce losses. Ultimately, multiple stressors including energy development must be managed collectively to maintain populations over time in priority landscapes. We have the capability to plan and implement a solution for sage-grouse conservation, but time is of the essence.

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Sage-grouse and energy development in Wyoming: conservation planning to minimize impacts

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The goal of this paper is to initiate conservation planning to minimize impacts to Greater sage-grouse (*Centrocercus urophasianus*) populations. Our objectives were to 1) use lek data to define sage-grouse core areas and to 2) empirically test across a large spatial extent the level of energy development that would cause increased lek inactivity and decreased abundance. We defined core areas using displaying male-sage grouse density using a 1-km2 grid for the entire state of Wyoming. We estimated 1% ordinal quartile bin break points to quantify grouse densities that when applied to all 1-km2 grid cells would contain approximately 25-, 50-, 75-, and 100% of known breeding male populations. We used chi-square and T-tests to compare the rate of lek inactivity and population abundance between leks experiencing no energy development and those experiencing 4 categorical levels of energy development. Our analysis demonstrates that a high proportion of breeding sage-grouse can be protected in a relatively small area and an asymptotic relationship between the proportion of the population and the area of Wyoming. Approximately 25% of the known breeding population is contained in 4% of the state. Likewise, 50% and 75% of the known breeding population can be contained in ~11% and 19% of the state respectively. We detected between 1.79 ($p < 0.005$) to 5.04 ($p < 0.001$) times greater inactivity in energy development. Leks that did not go inactive in development showed decreased abundance ranging from -17.0% ($p = 0.093$) up to -68.9% ($p < 0.001$). We detected no impacts to lek activity or abundance at development levels of < 1 well per section (1-12 wells within a 3.2-km buffer). Our core areas and development thresholds identify a starting point for the implementation of a spatial conservation strategy and should prioritize research, management, and implementation in an adaptive management framework.

Life on the edge: conservation of a trans-boundary sage-grouse population

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Declines in populations of sage-grouse (*Centrocercus urophasianus*) are widespread, and losses are exacerbated in the periphery of their range. In 2007 we initiated a study to estimate vital rates, examine habitat-use, and identify seasonal movements of sage-grouse in the Milk River Basin of northern Valley County, Montana, USA, and south-central Saskatchewan, Canada. The Milk River represents the northeast edge of the range of sage-grouse where birds breed and raise broods in remaining silver sagebrush (Artemesia cana) habitats. This population had vital rates indicative of a stable population in 2007. Nest success was 59%, and chick survival was 33% as estimated by flush and spotlight counts at 50 days post hatch. Adult female survival was 43%, after an 18% reduction in survival following the emergence West Nile virus in the late July. An exceptionally wet spring may have led to higher than average estimates of nest success and chick survival. In January 2008 we discovered that this population is migratory, traveling 60 – 121 km south of the Milk River out of silver sagebrush habitats and into big sagebrush (A. tridentata) in Montana. In spring 2008 all females, including the endangered population from Canada, returned to their respective breeding areas in silver sagebrush habitats. The migratory status of birds in the Milk River necessitates the conservation of a larger landscape than was initially envisioned. Trans-boundary movements between Canada and Montana highlight the need for implementation of conservation activities that transcend state and national boundaries.

Effects of wildfire (1999-2007) on greater sage-grouse and key sagebrush ecological systems in Nevada

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From the period 1999-2007, more than 6 million acres of Nevada's rangelands have burned. We wanted to determine the effects these fires have had on Greater sage-grouse (*Centrocercus urophasianus*) populations and populations in Nevada. We used Southwest Regional GAP Analysis Project (Nature Serve 2003) to estimate the extent of habitat alteration. We extracted four key sagebrush ecological types most representative of sage-grouse habitat and overlaid these features onto the range of Greater sage-grouse in Nevada. Fire polygons provided by the Bureau of Land Management were then added. We determined that there was a total of 21,894,043 acres of the 4 selected sagebrush ecological systems within the range of Greater sage-grouse in Nevada. Of this amount, 2,536,392 acres were burned during the last 9 fire seasons, equating to an approximate loss of 11.6 % of potentially suitable sage-grouse habitats in Nevada. We separated montane and low to mid elevation sagebrush ecological system types to determine the potential short-term and long-term losses of suitable sage-grouse habitats. We determined that approximately 1,954,024 acres (9%) were considered sagebrush ecological systems other than montane, which are the sagebrush habitats that are not likely to recover from wildfire within at least the next 25 years.

We overlaid Nevada's most recent lek dataset (January 2008) to determine the number of leks affected. We selected for fires >1,000 acres in size to conduct the analysis, representing more long-term, sizable losses. We then placed buffers around each fire polygon of 3.2, 6.4, and 9.6 kilometers to determine the potential effect on sage-grouse outside of, but in proximity to the fire polygons. Our analysis provided the following figures:

1) 307 lek locations (131 active) were actually burned within fire polygons >1,000 acres;
2) 696 lek locations (329 active) were within 3.2 km of these polygons;
3) 944 lek locations (454 active) were within 6.4 km of these polygons; and
4) 1,158 lek locations (551) were within 9.6 km of these polygons.

We currently recognize 1,981 lek locations in Nevada of which 912 are considered to be active. Using the 9.6 km buffer, we estimate that 58% of known leks and 60% of active leks could have been negatively affected by wildfire in Nevada.

Hixon sharptail area - 30 years of conservation action

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In 1977, an isolated and remnant population of Columbian sharp-tailed grouse was verified in West-Central Idaho with the discovery of a small lek. Additional searches in the vicinity resulted in locating two other small leks on the same 4,200-acre private ranch. The estimated spring population at this time was less than100 birds. A series of protection and management actions over the next 30 years have resulted in a 30,000-acre special management area and a significantly expanded population. Recent conservation challenges including exurban development and the probable loss of CRP will jeopardize some of the gains. Additional conservation actions are needed to secure the long term viability of this population. Among the many lessons learned during the course of this project, two critical ones are having a vision and a sustained effort to accomplish it.

Micro-habitat use of nesting greater sage-grouse in Idaho

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Greater sage-grouse nest sites (n=146) and random plots (n=138) were sampled during 2003-2005 throughout the population range in southern Idaho to describe differences of use vs. available habitat and between nest success and age classes. Standard methods used in the literature were used to measure habitat within 10 m from the center of the nest or random plot including: line intercept for canopy coverage of shrubs, Daubenmire frames for understory coverage, and drupe height of grasses. A modified Robel pole was used to measure horizontal cover from the perspective of the nesting hen. Multivariate analysis of variance revealed sage-grouse used sites with less cover of bare rock, more horizontal cover, taller grass, and greater canopy coverage of sagebrush. Principle component analysis was used to reduce the 91 variables to 3 components that accounted for 51% of the variance in the data. Principle component I had 31% of the variance and was represented by 8 measurements of shrub height. Component II (11% of variance) combined 8 variables of horizontal cover. Component III (9% of variance) used 6 variables of shrub density. Sage-grouse used nest sites with taller shrubs and less shrub density than available at random. Successful nests had greater horizontal cover than unsuccessful nests. Adult nests had greater shrub density and more horizontal cover than yearling nests. Generally, micro-habitat of nesting greater sage-grouse was within the recommended guidelines established for breeding habitat and grouse are likely selecting nest sites for concealment from predation and adequate views of approaching predators.

Nesting success and resource selection of greater sage-grouse in northwestern South Dakota

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Understanding population dynamics and resource selection is crucial in developing wildlife resource management plans, particularly for sensitive species. Greater sage-grouse (*Centrocercus urophasianus*) populations have declined range-wide at a rate of 2% per year from 1965 to 2003. In northwestern South Dakota, sage-grouse occupy habitats at the eastern edge of their range, and populations have generally declined over the long-term average. Reasons for the decline are mostly attributed to human-induced factors such as sagebrush degradation and removal, improper range management practices, oil and gas exploration, and West Nile virus infection. We conducted a 2-year study to investigate the nesting ecology of sage-grouse in northwestern South Dakota. Female sage-grouse were captured and radio-marked (n = 53) on traditional display grounds. Radio-marked hens were tracked to estimate nesting effort, nest success, and resource selection. Nest initiation was 95.9%, with an overall nest success of 45.6 ± 5.3%. Hens selected habitats with greater sagebrush canopy cover and nest bowl visual obstruction compared to random sites. Nest success models developed in Program MARK indicated taller grass structures increased nest success. Management of sage-grouse nesting habitat on the eastern edge of their range should focus on increasing levels of sagebrush density and canopy cover while maintaining cover and height of grasses. We recommend that land managers maintain maximum grass heights of 26 cm.

Nest site selection of greater sage-grouse: the importance of scale

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Understanding the relative importance of landscape-scale versus local scale habitat selection is essential for developing conservation plans for sensitive species. Our objectives were to: 1) evaluate the importance of landscape vs. local scale factors in nest site selection, 2) assess the influence of CBNG development on nest site selection, 3) spatially depict nesting habitat suitability in a GIS to identify areas with a high probability of use, and 4) validate the spatially explicit model with an independent nest dataset and known lek locations throughout the PRB. Landscape and patch context matter in sage-grouse nest site selection and improved local scale model fit by 41.6 AIC points; however variables representing local scale nest site selection were the strongest predictors. After controlling for habitat, sage-grouse avoided CBNG roads (16.72 AIC point better than habitat alone; âdistroads = 0.0002, $p < 0.000$), however model validation generated uncertainty in this result. Our spatially explicit nest occurrences model was highly predictive on an independent nest data set (validation $R2 = 0.96$) and was also able to predict lek locations on the landscape. Across the PRB, there was approximately twice the amount of predicted nesting habitat surrounding leks than random locations at very large extents (3-, 5-, 10-km buffers; $p < 0.001$). A multi-scale approach is needed to synthesize local scale habitat research and treatments into coordinated efforts that sum to landscape conservation. Resulting models provide resource managers with a practical tool to guide conservation planning and identify where conservation should occur.

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The effects of perch discouragers on raptor and corvid use of utility poles

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Studies have shown that the increase of man-made structures, such as fence posts, power poles, and windmills, has lead to an increase in raptor and corvid visitation to the affected areas. This has enhanced raptor and corvid foraging and predation efficiency because of the increased availability of perch, nesting and roosting sites. The San Juan County Gunnison sage-grouse (*Centrocercus minimus*) local working group had identified the need to evaluate the effects of human infrastructure, such as powerlines, on local populations. Methods to minimize the potential impacts of powerlines include retrofitting these structures with perch discouragers to deter raptors and corvids from perching. We evaluated the efficacy of five different perch discouragers mounted on power poles to prevent or reduce perching by raptors and corvids. The study took place along an 11 km stretch of powerline located within the range of the Gunnison Sage-grouse population in San Juan County, Utah. The powerline was surveyed from January to April in 2007 and 2008. Seven species of raptors and 2 species of corvids were recorded. Golden Eagles were the dominant species recorded perching on the power poles. Preliminary data suggest that the perch discouragers have not been effective at deterring raptors or corvids from perching on the study poles because of insulators and insulator covers providing safe perch sites. This trend is apparent for each species.

Predicting the attendance probability of greater sage-grouse at lek sites in south-central Idaho: preliminary analysis

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Recent trends based on lek counts indicate populations of greater sage-grouse (*Centrocercus urophasianus*) are generally declining throughout their range. Our objective was to estimate the probability of birds attending leks in order to relate counts of birds at leks to the actual population abundance. We used mark-resighting techniques to model the probability of male greater sage-grouse attending leks. Birds were captured in the winter of 2006 and 2007 and fitted with 16.5 g necklace style radio transmitters. Triangulation from 2 locations off each lek was used to "re-sight" marked birds. We fit a Cormack-Jolly-Seber model to these data using program MARK. We restricted our predictor variables to time (Julian date), year, age of birds (adult or yearling), and their interactions. The top model chosen by AIC model selection procedures included the variables of year and a quadratic time trend. The second-best model, with a Δ AIC value of 0.88 included age and a quadratic time trend. These results suggest that the probability of male sage-grouse attending leks peaked near the middle of April of both years at 0.77 (SE = 0.053), was different for adults and yearlings, and varied between years. We have completed the 2008 field season and will continue to collect data in the spring of 2009. For our final analysis of the complete data set, we will include additional variables such as time of day and weather in our candidate set of models, which should result in more precise estimates of attendance probability.

Lek counts underestimate lek attendance based on genetic sampling of molted feathers

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Endangered species are sensitive to fragmentation and decreasing population sizes so conducting accurate censuses are essential for conservation planning. Sage-Grouse are endangered in Alberta and have declined by 66%-92% in the last 35 years. Lek censuses in Alberta consist of counting all males on all active leks in a single late April morning because peak male attendance occurs during this week. To determine how accurate conventional lek censuses are, 1422 samples (327 blood/tissue and 1095 molted feathers) were collected between 1998-2007 from 9 leks in Alberta, Canada and were genotyped at 13 microsatellite loci. “Molted feathers” are in most cases feathers pulled out during fighting so DNA quality was high. Of the 1422 samples, 604 unique individuals were identified and of the 1095 non-invasive samples, 1093 could be analyzed at >7 microsatellite loci. In years where feathers were collected intensively (every feather collected) one or more times from a lek, up to 2.2X more males were detected than conventional lek counts. Few females were sampled from feathers. Effort and weather primarily impacted male detection rate. Feathers also provided other useful data on males through re-sampling over years. Most males were sampled in one or two lekking seasons, but some males were found to be living up to at least seven years. We also found evidence for only three males switching leks over five years. Our results show that not all males attend a lek on a given morning causing traditional lek counts to underestimate the population size by approximately 15-50%.

Allee and Ricker effects on persistence of declining sage-grouse populations

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The Allee effect, or declining per capita growth rates at low population sizes, could negatively impact the persistence of declining populations of Greater Sage Grouse while the Ricker effect, declining per capita growth rates at higher population sizes produces an objective carrying capacity for stable or increasing populations. We estimated the parameters of a discrete time, stochastic growth model incorporating both the Allee and Ricker effects from annual lek counts in the Snake River Plain, Idaho and eastern Washington 1965-2003. These data provide highly significant evidence for both the Allee and Ricker effects in sage grouse populations. The model provides clear criterion for defining a lower threshold for numbers attending leks below which the populations are likely to decline to extinction. Using this threshold and estimated parameters for the stochastic growth model we could evaluate the probability of persistence or extinction of populations and metapopulations of sage grouse throughout their range. Applying the model to populations varying stochastically at the upper end of the abundance continuum provides a way to evaluate factors influencing carrying capacity of grouse. Sensitivity analysis can be applied to this model and to stage-structured models of sage grouse populations to identify management actions most likely to reverse the long-term declines of the species throughout the west and predict the probable impacts of global climate change.

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Banquet Speaker

James Bland

Jim Bland began conducting blue grouse surveys for the California Department of Fish and Game in 1992 and since then, he has become one of the preeminent experts on blue grouse in California. Jim received his BS in Wildlife Management at Humboldt State University in 1982 and began his graduate career with a great interest in montane gallinaceous birds of Asia. He conducted field studies of Nepalese pheasant species in the Himalaya Region, and also a study of Lady Amherst Pheasant habitats in Yunnan, China. Jim completed his MS Thesis entitled, "Himalayan Snowcocks in America," at the University of Wisconsin, Madison, in 1987. Jim enrolled in a PhD program at UCLA, was awarded a Fulbright scholarship, and studied Sherpa forest use and its impact on understory passerines in the Everest Region of Nepal, and he is still working on his dissertation. Since then, Jim has taught various courses in biology at Santa Monica College, spending his breaks studying Sclater's Monal in Yunnan with support from San Diego Zoo.

While continuing to conduct surveys of blue grouse in California, now (and again) called sooty grouse, Jim began to formulate hypotheses regarding habitat selection and mating systems of grouse in the southern Sierra Nevada. Jim had become convinced that the Sierran subspecies was closely associated with big trees and old forest, and felt that these associations were not adequately recognized. So he presented the California Department of Fish and Game with a proposal to conduct the first quantitative habitat study of sooty grouse in the Sierra Nevada and he is now in his 2nd of a 3-year field study. In the process of describing habitat selection of sooty grouse, particularly regarding breeding ranges, Jim has discovered interesting mating systems with parallels to lekking grouse and forest grouse of Europe and Asia. Jim will present some of his preliminary findings and entertaining footage of sooty grouse behavior in the southern Sierra Nevada.

Robert L. Patterson Award

The Robert L. Patterson Award is being established in honor of his strong commitment to the conservation of sage-grouse and his seminal work, *The Sage Grouse in Wyoming*, published in 1952. The award recognizes outstanding individuals and organizations that have worked to conserve and manage Gunnison and greater sage-grouse and Columbian sharp-tailed grouse. The first Patterson Award will be presented during the banquet.

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